

ABSTRACT

Evidence about the health hazards of exposure of humans and animals to a wide range of chemical and physical pollutants, especially pesticides and radiations, were reported in several articles, while the mutagenic and/or the carcinogenic effects are conflicting and inconclusive. Various genotoxic effects have been reported, including chromosomal damage, induction of micronuclei and sister chromatid exchange in different experimental models as well as DNA damage.

On the other hand, laser therapy has gained wide acceptance and application in many medical disciplines. Nevertheless, during surgical procedures, the thermal destruction of tissue creates a smoke plume. Recent research data indicate that pyrolysates liberated during vaporisation of tissue induce DNA damage. However, assessing potential health hazards during medical laser treatment requires comprehensive insight into the cytotoxic, genotoxic, clastogenic and mutagenic capacity of laser pyrolysis products (LPP) (**Plappert *et al.*, 1999**).

During the last 10 years, a rapid and sensitive technique, the comet assay [single-cell gel electrophoresis (SCGE)] has gained widespread acceptance for genotoxicity testing. Compared with other genotoxicity tests, the comet assay is a cheap and simple method. Although the comet assay requires isolated cells of the

same type, there has been increasing interest in this test in the last years, mainly because of its advantages, sensitivity and rapidity. The comet assay permits the detection of primary DNA damage and the study of repair kinetics at the level of single cells. It has recently been used for various *in vitro* and *in vivo* studies to monitor exposure to mutagens and carcinogens that induce DNA damage (Qiu, *et. al.*, 2003).

In the present study, the alkaline comet assay was used to evaluate the genotoxic effects of a type II synthetic pyrethroid pesticide (cypermethrin) and laser radiations (diode laser (650 nm) 500mw) on the liver cells of white rats.

Sixty-six apparently healthy adult male Swiss albino rats were used in the present study. Rats, weighing 120-180 g, approximately 4 months old of age. Animals were randomized by weight. Rats were randomly divided in to experimental groups and sub-groups (3 animals/ group) as follows:

1. Control (-) no treatment.
2. Control (+) treated by H₂O₂.
3. Treatment the cypermethrin treated animal groups were exposed orally to a single dose of one of three different dose levels (1/5, 1/10 or 1/30 LD₅₀) and different sacrificed time (1,7,14 days). Cypermethrin was solubilized in water.

4. Treatment the diode laser (650 nm) treated animal groups were exposed to a single dose for one of three different durations (1, 5 or 10 min.) and different sacrificed time (1,7,14 days).

5. Combination treatment between Laser and Cypermethrin:

- a. Low dose of cypermethrin (1/30 LD₅₀) with low dose of diode laser (1 min), sacrificed after 14 days.
- b. High dose of Cypermethrin 1/5 LD₅₀, after 6 days exposure of high laser (10 min), then sacrificed after 1 day.

The results of cypermethrin indicated that all pesticide treatments alone yielded statistically significant DNA damage ($P < 0.0001$). The DNA damage increased with the increased of the concentration of dose levels. While, the results of diode laser (650nm) showed that highly statistically significant increase of damaged DNA ($P < 0.0001$). Also, DNA damage decreased with the increase of the time after exposure. Combination treatments of low dose or high dose of both cypermethrin and diode laser increased the damage DNA, ($P < 0.0001$) for low dose and ($P < 0.0001$) for high dose, respectively.

Taken together, our results show that the SCG test is a sensitive genotoxicity test for different DNA damaging by chemical and physical agents. The results of the present study clearly indicate that each of cypermethrin and laser irradiation

alone possesses the potential to cause alterations in the cellular DNA in rat liver cells *in vivo*, indicating potential mutagenic effects. It could be suggested that the combination of cypermethrin treatment with laser irradiation would have a synergistic genotoxic effect as cypermethrin may cause DNA damage, scission of DNA synthesis and/or inhibition of DNA repair. Human exposure to these agents should be restricted.

CONTENTS

	Page
Introduction	1
Review of Literature:	4
-Laser Light Characteristics	4
• Monochromaticity	4
• Collimation	4
• Coherence	5
-Laser Components	6
• Active medium	6
• Optical cavity	7
• Energy source	7
• Cooling system	7
-Principles of Laser Irradiation	8
• Laser Design	9
-Modes of Operation	11
• Continuous mode	11
• Pulsed mode	11
• Q-switching	12
-Types of Laser	13
• Atomic and Ionic Gas Laser	13
• Molecular Gas Lasers	15
• Semiconductor Lasers	16
• Excimer Lasers	17
• Dye Lasers	18
• Free Electron Laser	18
• Solid State Laser	19
-Laser Tissue Interaction	21
• Photothermal Effect	22
• Photochemical Effect	24
• Non-linear Effect	25
• Thermal Properties of the Tissue	26
-Radiation	27
• Radiation therapy	31
• Hazards associated with the surgical use of lasers	31
• Genotoxic, clastogenic and mutagenic potential of substances from laser irradiation	32
-The comet assay [single-cell gel electrophoresis (SCGE)]	33
-Pesticides exposure and its impact on human health	35

	Page
-The potential genotoxic risk of exposure to complex pesticide mixtures	36
-The potential genotoxic risk of different pesticides	41
-Natural pyrethrin and synthetic pyrethroid pesticides	42
-The potential genotoxic risk of different pyrethroid insecticides	44
-The potential genotoxic risk of cypermethrin	47
Aim of the work	56
Materials and Method	57
• Tested pesticide	57
• Irradiation using diode laser beams	59
• Experimental Animals	59
• Transverse Laparotomy	61
• Sampling	62
• The Comet Assay	62
• Evaluation of DNA damage	63
• Statistical analysis	63
Results	64
• DNA damaged of cells by the tested pesticide “cypermethrin”	68
• DNA damaged of cells induced by the tested diode laser(650nm)	78
• DNA damaged of cells induced by the combined Treatment of diode laser (650nm) and pesticide (cypermethrin) treatments	87
Discussion	92
Conclusion	105
Recommendations and Future Works	106
References	108